

Conceptual Design of Neutron Imaging Instruments for the High Brilliance Neutron Source (HBS)

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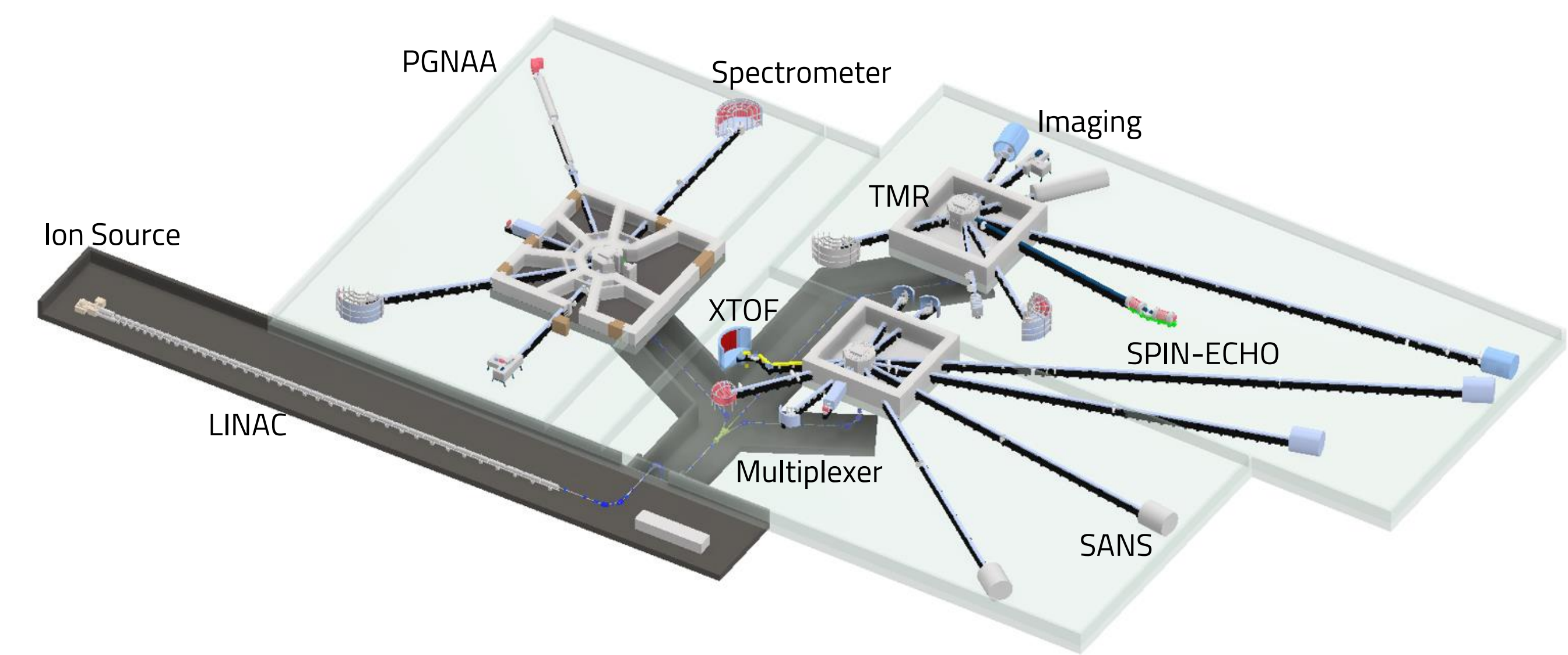
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High Brilliance Neutron Source (HBS) Project

- High Current Accelerator-driven Neutron Source (HiCANS)
- Fast neutrons will be generated by the interaction of a 70 MeV, 89.3 mA proton current beam with a Tantalum target (100 kW)

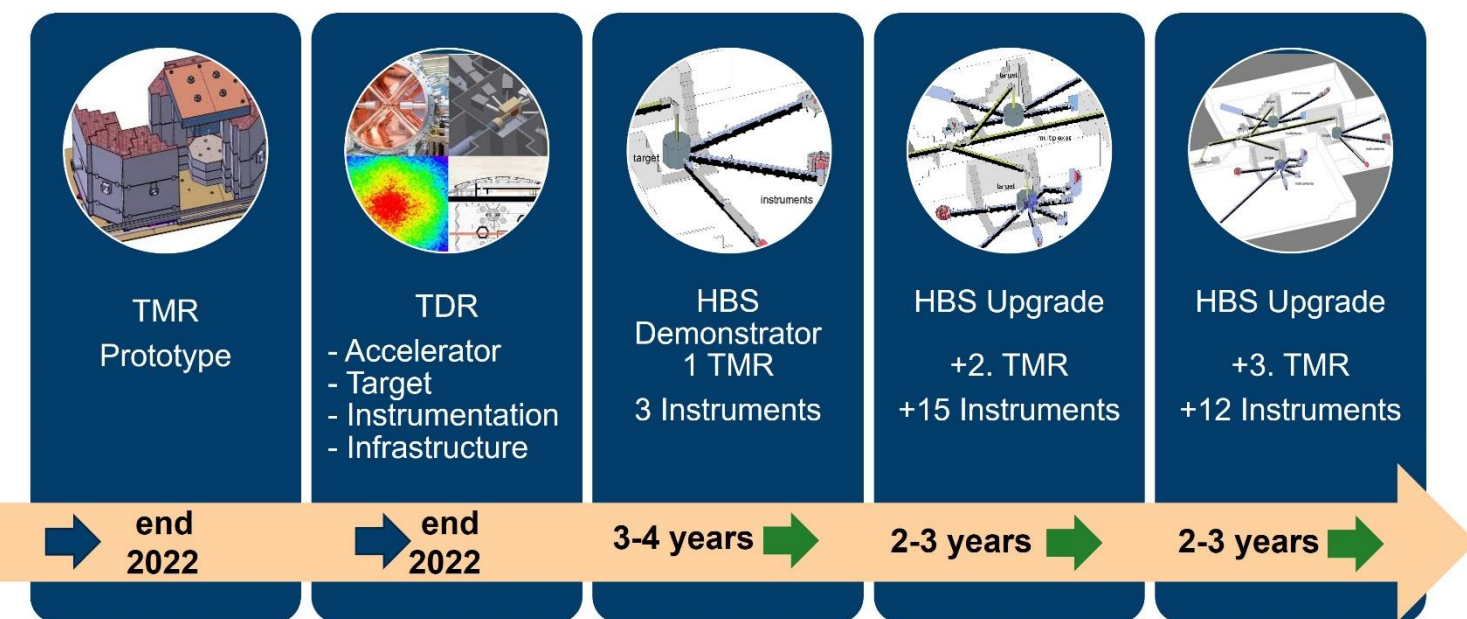


- 3 Target-Moderator-Reflector (TMR) units, with different moderators to achieve the desired beam characteristics for each instrument

Frequency [Hz]	Period [ms]	Duty cycle [%]	Pulse width [μs]	Purpose	Moderators
24	41.7	1.60	667	Long pulse, cold neutrons	Solid CH ₄ , para-H ₂
96	10.4	1.60	167	Medium pulse, thermal neutrons	H ₂ O
96	10.4	1.60	167 (down to 10)	Medium-short pulses, epithermal/fast neutrons	D ₂ O, ⁷ LiF

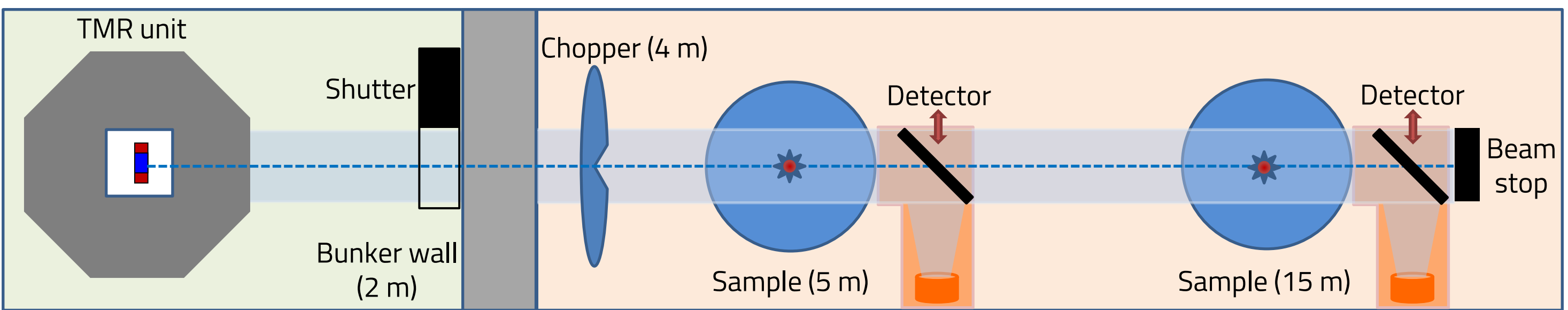
- Instruments under design for the Technical Design Report (TDR):

- 3 Analytics Instruments
- 5 Diffractometers
- 5 Large Scale Structure Instruments
- 7 Spectrometers
- 5 Imaging Instruments

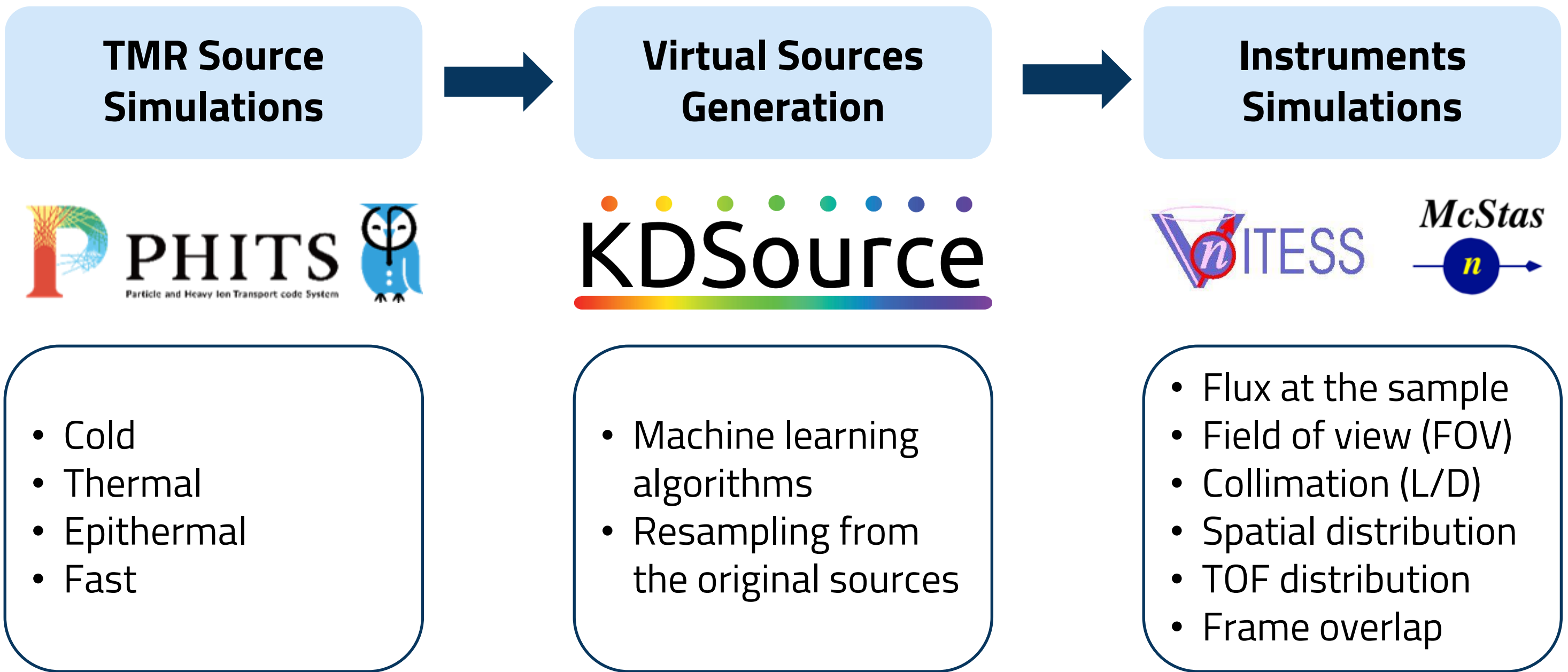


Neutron Imaging Instruments Design and Simulations

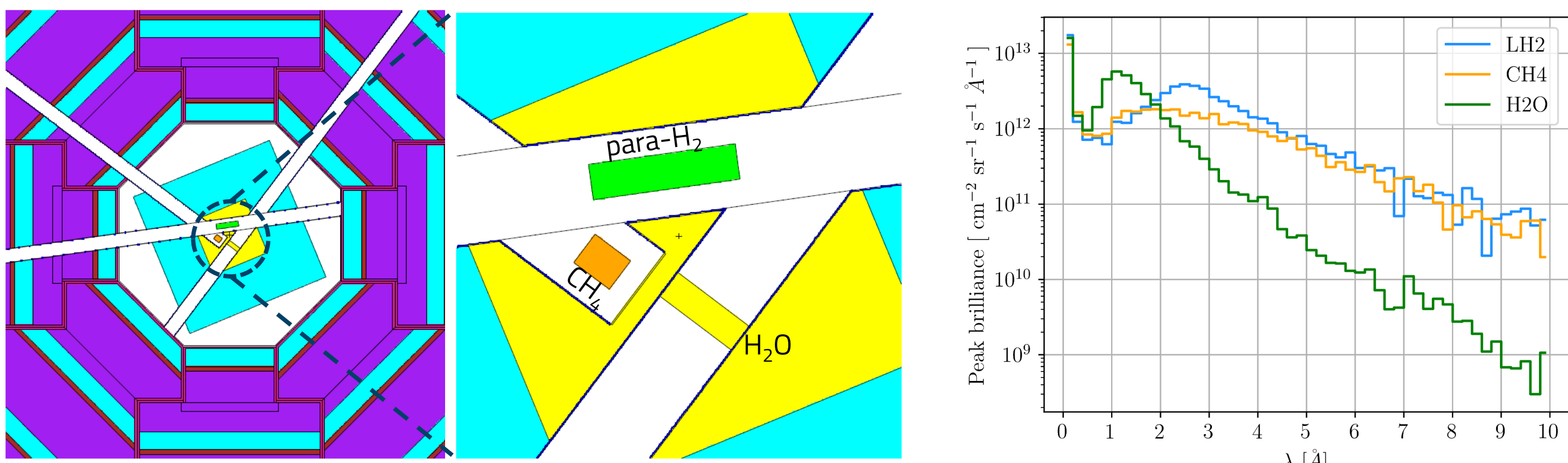
- Schematic layout for the cold neutron imaging instrument at the HBS



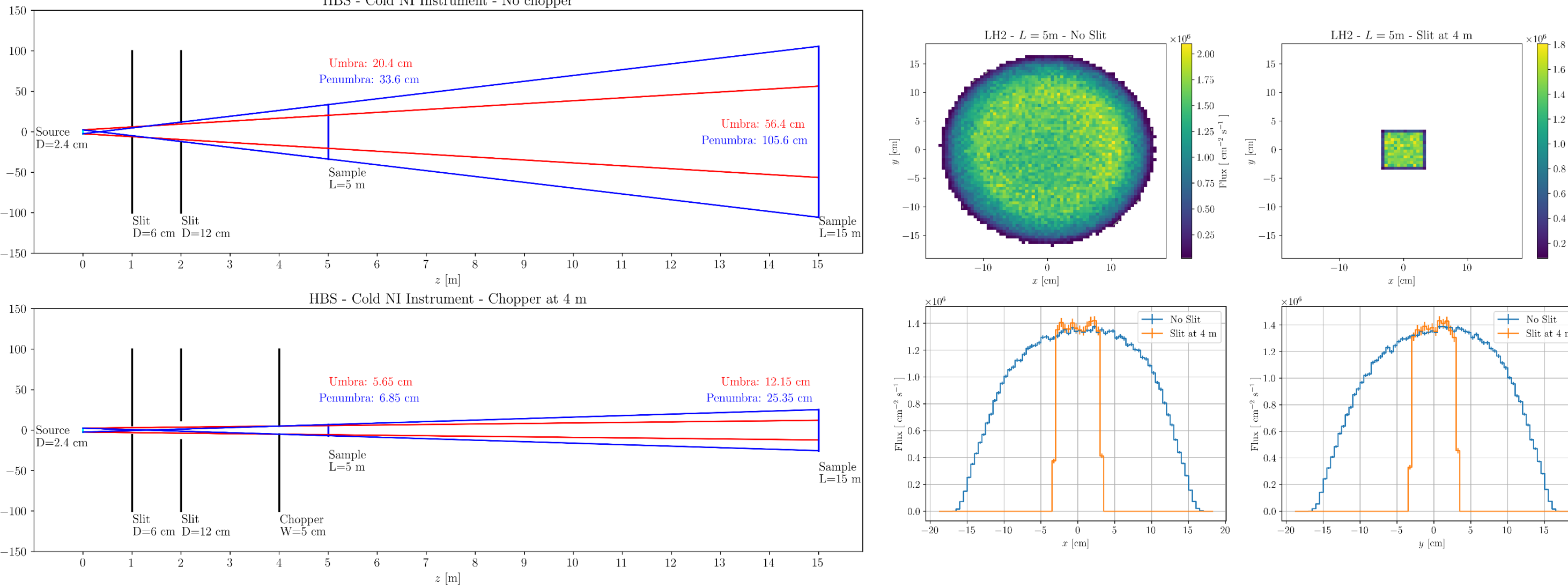
- Design and simulations workflow



- PHITS simulations for the TMR unit



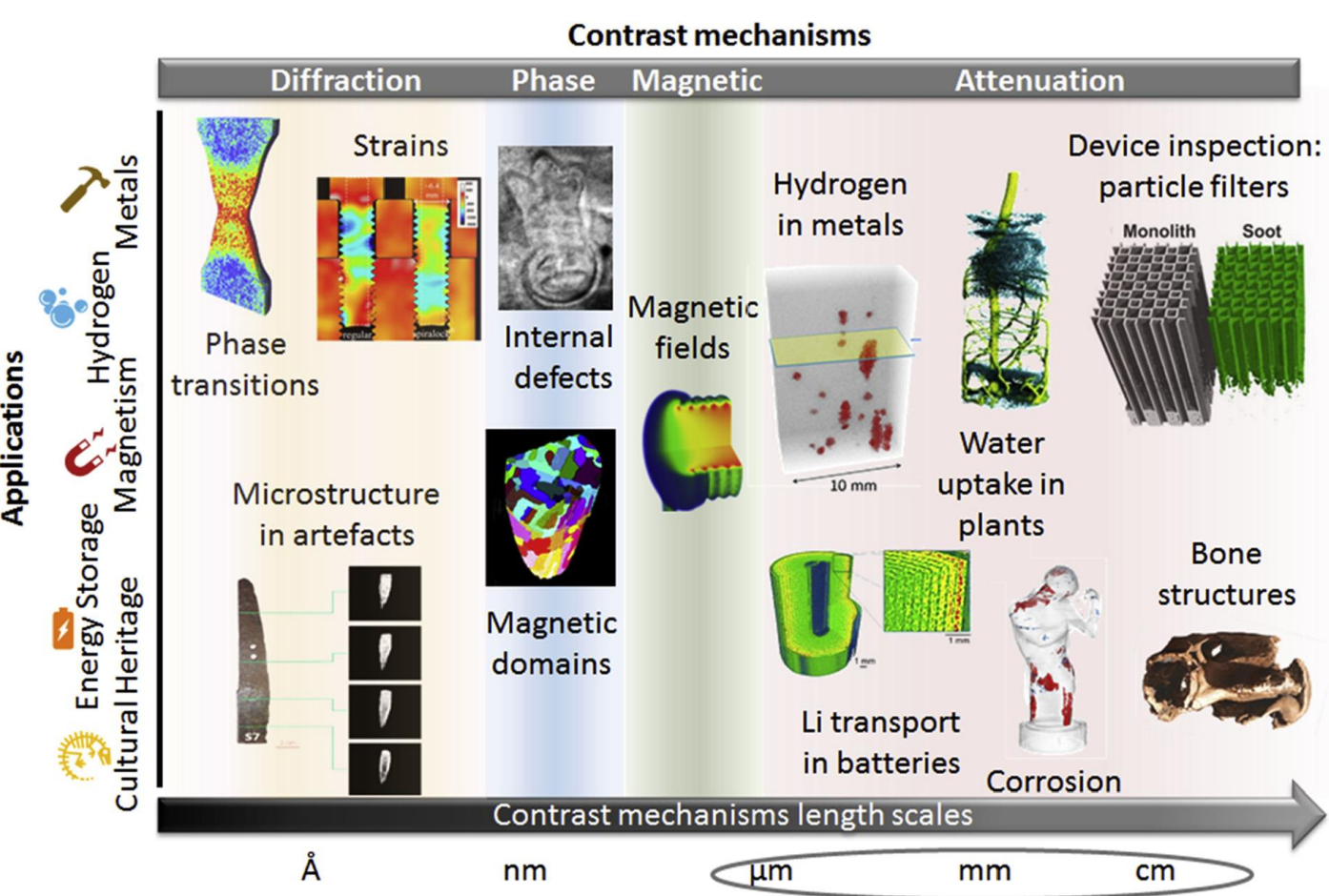
- KDSOURCE + McStas simulations for the instruments



Neutron Imaging Instruments Parameters

- Expected parameters for the neutron imaging instruments (simulations and design are under progress)

Instrument	Energy range	Wavelength range	Chopper	Guide	Sample positions [m]	Flux at sample [n/(cm² s)]	FOV [cm²]	Collimation L/D	Spatial resolution	Energy/wavelength resolution
Cold (96 Hz)	0-10 meV	>2.9 Å	Yes	No	5 15	3x10 ⁶ 3x10 ⁵	5 x 5 15 x 15	200 625	High	1 - 15 Å / 8 Å, 5% 1 - 15 Å / 3 Å, 1%
Bragg edge (96 Hz)	0-10 meV	>2.9 Å	Yes	Yes	30	5x10 ⁶	10 x 10	500	High	1 - 15 Å / 1.5 Å, 0.5%
Thermal (96 Hz)	10 meV - 0.5 eV	0.4 - 2.9 Å	No	No	4 10	3x10 ⁷ Up to 3x10 ⁶	15 x 15 35 x 35	65 165 (up to 500)	High	No
Epithermal	0.5 eV - 10 keV	3 mÅ - 0.4 Å	No	No	35	2x10 ⁵	50 x 50	600	Low	1 keV, 2%
Fast	1 keV - 70 MeV	< 3 mÅ	No	No	10	Up to 8x10 ⁷	20 x 20	100 (up to 500)	Low	No



Contrast mechanisms and application fields
Kardjilov, N. (2018). Advances in neutron imaging. Materials Today, 21(6), 652-672